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Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

No. 105

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WEST EUROPE

FRANCE

DEFENSE ANALYST WRITES BOOK ON NUCLEAR THREAT

New Delhi PATRIOT in English 15 Jun 81 p 7

[Text] India faces a three-pronged nuclear threat which can be met by rectifying the nuclear asymmetry that exists between the country and its immediate neighbours, according to Mr K Subrahmanyam, defence analyst, reports UNI.

In his new book, 'Nuclear Myths and Realities--India's Dilema,' Mr Subrahmanyam analyses the consequences of India's non-nuclear posture while the surrounding regions are getting nuclearised.

Observing that nuclear weapons can be deterred only by nuclear weapons and not by any additional margins of conventional weapons, the author refers to the case of India facing a nuclear China, a likely nuclear Pakistan and the continual US stationing of aircraft carriers in the Indian Ocean.

"A China with obsolete conventional equipment and a nuclear arsenal will not be in a position to adopt a strategy of flexible response. Its vulnerability in conventional equipment may compel it to reduce the nuclear threshold and steer it towards a doctrine analogous to doctrine which envisages the first use of nuclear weapons on the ground that NATO is inferior to the Warsaw Pact in conventional strength' argues Mr Subrahmanyam, who is Director of the Indian Institute for Defence Studies and Analyses.

"This is bound to happen even if the Chinese were to start assigning a high priority for conventional arms modernization or the west decides to assist China in a big way to modernise its conventional weaponry because either process will be time-consuming and the obsoleteness of Chinese arms cannot be made up before perhaps mid-1990s,' the author adds.

On Pakistan, Mr Subrahmanyam says a general analysis of 'the issue from the point of view of military considerations, shows very clearly that a non-nuclear India will be at a terrible disadvantage vis-a-vis a nuclear-armed Pakistan.'

He asserts that 'besides military aspects there are a number of other consequences flowing from a Pakistani military capability, which deserve close attention by India.' A nuclear Pakistan in an asymmetric situation will totally countervail India within the subcontinent.'

The author argues that 'with a nuclear China and a nuclear Pakistan the demands of the smaller powers of the subcontinent on India will become increasingly difficult to meet.'

The third dimension of nuclear threat to India to be considered Mr Subrahmanyam says, is the repetition of the attempt at coercive diplomacy by the United States as happened at the time of the enterprises mission into the Bay of Bengal in December, 1971. This has been treated as an 'attempted use of force without war' by some American academics.

Mr Subranmanyam says that with a large and continuous presence of US naval forces in the Indian Ocean 'one can envisage some possibilities of a conflict of interests between India and the US for instance the US may favour and covertly support an induced change of regime in one of the island states in the Indian Ocean and the legitimate Government of the State may appeal to India for help.'

It was also possible that in the framework of western security consensus covering Pakistan, "If there is a future conflict between India and Pakistan, the country will have to take into account the possibility of a US intervention in favour of Pakistan' the author adds.

CSO: 5100/7112

INADEQUATE POWER LIMITS USE OF CALCUTTA CYCLOTRON

Calcutta THE STATESMAN in English 17 Jun 81 p 4

[Text] Bombay, June 16--The Variable Energy Cyclotron (VEC), developed by the Bhabha Atomic Research Centre in Calcutta could not be operated regularly for nearly three years, because of irregular power supply.

The machine could be operated regularly only after diesel generators of 2 MVA capacity were installed in January 1981. But the constrains on power availability from these generators still limit the cyclotron operation to acceleration of alpha particles.

This information is contained in Nuclear India, a journal published by the Department of Atomic Energy.

At least 5 MVA electrical power is required for exploiting the full capacity of the machine.

The cyclotron can give well focussed beams of protons, deuterons, alpha particles and heavy lone, like carbon oxygen or nitrogen. This versatility in accelerating various types of particles as well as broad energy range of the machine places it amongst half a dozen cyclotrons of this type in the world.

The sophisticated machine wholly fabricated in India with only 10% of very special material brought from abroad will help research by national laboratories and universities in front-line areas in nuclear physics and chemistry, solid state physics, radiation physics and chemistry, isotope production for application in medicine, and industry and agriculture.

Construction of the cyclotron was undertaken in Calcutta in the newly-developed Bidhan Nagar in 1970. The total cost of the project was Rs 10 crores. Its fabrication in India has created a skilled work force and build-up of high technology.

Initially, an internal beam of alpha particles was accelerated on June 16, 1977, and the first external beam in July 1978. Then on, it could not be operated in a regular manner, because the continuous supply of power was not available in Calcutta.

CSO: 5100/7113

'PTI': BALL IN U.S. COURT FOR TARAPUR SOLUTION

New Delhi PATRIOT in English 16 Jun 81 p 2

[Article by P. B. Sinha]

[Text]

THE fate of the Indo-US nuclear cooperation agreement on Tarapur has been hanging in the balance for quite some time. The element of uncertainty about its future was more or less removed by the External Affairs Minister in his statement of 29 April, informing the Lok Sabha about the outcome of the discussions Mr Homi N Sethna, Chairman of the Atomic Energy Commission, and Mr Eric Gonsalves, Secretary in the External Affairs Ministry had with high US officials in Washington recently. Mr P V Narasimha Rao said that during the talks in Washington the US side had indicated that they "could not hold out any hope for further fuel supplies" and had suggested for consideration an "amicable termination" of the agreement as one possibility. Further discussions would be held in India shortly on modalities to that end.

Two days later, on 1 May the US State Department was reported to have said that the US had not yet decided whether to terminate shipments of enriched uranium for India's reactor at Tarapur. "These discussions are continuing and no final decision has been made", said the spokesman, Mr Dean Fischer.

These statements, coupled with the reluctance and unwillingness on the part of the United States to honour its commitments by withholding supplies of enriched uranium for Tarapur, have sealed the fate of the agreement of 1963. This development is neither sudden nor surprising, however. The problems began with the passage of the Nuclear Non-Proliferation Act (NPA) by the US Congress in 1978. The Act prohibits the US from supplying nuclear fuel and equipment to countries which have not signed the Nuclear Non-Proliferation Treaty (NPT) or have not agreed to full-scope safeguards on all nuclear facilities—indigenous or foreign aided.

That the new US Administration would not be inclined to implement the Tarapur Agreement of 1963 was clear from the way an anti-India campaign was launched in the United States on the nuclear issue soon after Ronald Reagan assumed office. On 5 February, Senator John Glenn (Democrat), in a letter to the new President, gave currency to a rumour that India had authorised re-processing of spent fuel from Tarapur in contravention of the 1963 agreement and urged the President to stop giving nuclear fuel to India. India denied any such plans.

On its part, India has not committed any breach of the Tarapur agreement. In the Pokharan explosion, contrary to the allegations made by some, India did not use any material or equipment connected, directly or indirectly, with TAPS. Rather India has been strictly observing in letter and in spirit, all the conditions laid down in the agreement.

Article II-A enjoins India to operate TAPS "on no other special nuclear material than that made available by the United States Commission...". Because of erratic supply of fuel from the US, India has been running the Tarapur plant for the past three years much below its capacity—only 65 to 70 per cent—but it has not used enriched uranium from any other source to run the station to its full capacity. Also, default on the part of the US in making regular supplies of fuel was a sufficient ground for India to have declared that the agreement was terminated, but it did not lose patience. State Department officials too reportedly believe that withholding further shipment of fuel would be a breach of the agreement. India is still willing to fully implement the agreement. In fact, one of the purposes of the Sethna-Gonsalves mission to Washington in April was to reiterate India's desire to continue the nuclear pact.

Closely connected with the inadequacy of the available enriched uranium is the problem of storage of spent fuel from Tarapur. The US has been reluctant to remove it though India has requested it to do so. The enormous cost involved in its transportation out of India and its disposal might have been the reasons behind the US unwillingness. India,

of course, could have solved both these problems by re-processing the spent fuel in the re-processing plant at Tarapur. But, conforming to the conditions of the agreement, it has not done so. The above facts clearly show the performances of the US and India under the bilateral nuclear cooperation agreement.

Under the circumstaces, can the Indo-US nuclear pact be saved? Suppose President Reagan, if he chooses to honour the agreement, exercises his executive authority and, circumventing the NPA, secures Congressional clearance for another shipment of enriched uranium. Would that solve the problem? The same process would have to be gone through every time the question of shipment of enriched uranium comes up and the President may not like to exercise his ultimate authority again. Or, a new Administration might adopt a rigid posture insofar as the application of NPA in such cases is concerned. Only the annulment of the NPA can bring a lasting solution. Also, if India agrees to addition of new conditions in the agreement of 1963 which would be in accordance with the NPA, the agreement can still work.

But both these contingencies being clearly beyond the realm of probability, the Tarapur agreement, for all practical purposes, is virtually dead. What remains now is a formal declaration to that effect, to give a decent burial to the agreement and to "settle" the question of succession.

Under Article II-D of the agreement, India holds exclusive title to the fuel it has purchased from the United States. The spent fuel, too, is a material which has the potency of being made re-usable as fuel in the Tarapur Plant. So, in a way, even spent fuel does not cease to be reactor fuel so long as it remains capable of producing fuel for the plant. Moreover, the U.S. can claim the right to have a say about the manner in which spent fuel is to be disposed of only on the basis of the agreement. The moment the agreement is terminated the US would forfeit any right whatsoever on the way the spent fuel would be handled.

The US insistence on having a say on the mode of disposal of the spent fuel after the agreement becomes ineffective would be an 'intrusion into India's sovereignty.' Similarly, the Tarapur plant is under safeguards by virtue of the Indo-US bilateral accord. When that accord ceases, India could not be made to accept the safeguards any more.

India is also opposed to the very basis of unilateral alteration of a bilateral agreement between two sovereign countries by either of them introducing some extraneous considerations, even if they spring from a newly enacted law of that country. It is rightly disputed if the US, in the name of NPA, can arrogate to itself the authority of imposing stipulations with retrospective effect on an agreement with another independent and sovereign country which has all the traits of a binding treaty.

Re-negotiation of the Tarapur agreement and insertion of new conditions in it can be done only with the concurrence of India which, obviously is not the case here. The blame for the failure of the Indo-US nuclear accord due to India's refusal to re-negotiate it, as pressed for by the US, thus, cannot be laid at India's door.

The backing out of its commitments by the United States and the consequent termination of the agreement of 1963 would have important implications which deserve consideration. The most significant, and welcome, result of this development from India's point of view would be India's freedom to operate the Tarapur plant as would suit it best.

India could procure fuel from other countries or fabricate it indigenously. There are reports that India can run TAPS with its own mixed oxide fuel — a mixture of plutonium oxide and uranium oxide — after the available stock of enriched uranium is exhausted. India could reprocess the Tarapur spent fuel and solve the twin problems of storage and fuel. Doubts and uncertainty haunting the Tarapur power plant for the last few years would wither away and TAPS could run on full capacity. Not only this, the plutonium recovered after reprocessing of the spent fuel would help develop fast breeder reactor technology in India.

During his conversation with Mr Eric Gonsalves, Mr Alexander Haig Secretary of State, was reported to have said that the friendship between India and the US is 'an act of faith for me.' He also said that President Reagan took 'vigorous interest in Indo-US relations'. Tarapur is a test case. The US Administration should not go back on its commitments.

But in this respect, knowledgeable observers hold that the Reagan Administration came to the decision of ending the fuel supplies to India 'reluctantly, arguing that it was 'pushed into a corner' by the nuclear supply policies of the Carter Administration and by the NPA, which provides 'little leeway.'

Then, if the Reagan Administration feels so tied down on the issue and cannot honour the agreement any longer, it can at least minimise the likely damage to Indo-US relations by making the disengagement as smooth and graceful as possible.

According to a report, the US legislation on non-proliferation—the NPA of 1978—is undergoing modifications which would make it possible for a country like India to process its own fuel for Tarapur. But all other steps for an 'amicable termination' of the agreement should be taken soon. The ball is now in the US court.

CSO: 5100/7114

ENERGY MINISTRY REPORTS NUCLEAR POWER COSTS

New Delhi PATRIOT in English 19 Jun 81 p 5

[Text]

THE cost of power generation per unit from new nuclear power projects will be more than double than that of the existing ones, according to the latest estimates on cost of power generation worked out by the department of power in the Energy Ministry reports UNI.

The present average cost of power generation per kwh for the existing nuclear power stations, including the Tarapur and Rajasthan atomic power projects is about 17 paise. The cost of power generation per kwh for new nuclear power projects is estimated to be about 35 paise.

The average cost of power generation from the operating thermal power stations in the country is 25 to 35 paise per kwh, according to official sources.

The average cost of power generation from hydel stations at present works out to 12 to 15 paise per kwh. The figure for diesel generating sets came to about one rupee per kwh.

The overall cost of power generation depends on the ratio of hydel, thermal, nuclear and diesel power stations and the capital cost of individual projects as also the cost of fuel, particularly in the case of nuclear, thermal and diesel power stations.

The cost of power generation in the case of hydel stations varies from three paise per kwh in Punjab to 26 paise per kwh in West Bengal.

Similarly, the cost of power from thermal stations also varies form 12 paise per kwh in Rajasthan to Rs 1.3 per kwh in Jammu and Kashmir.

Meanwhile the first unit of the Rajasthan Atomic Power Project at Rawatbhata, near Kota, has been recommissioned.

The unit was closed down on 24 May due to technical fault.

The unit is generating about 2.2 million units now and is expected to yield more than 3 million units a day according to a RAPP spokesman.

The second unit of the RAPP is producing about 2.5 million units daily.

CSO: 5100/7116

BRIEFS

RAJASTHAN ATOMIC UNIT--Jaipur, June 18 (UNI): The first unit of the Rajasthan atomic power project (RAPP) at Rawatbhata, near Kota, was recommissioned yesterday. The unit was closed down on May 24 due to a technical fault. The unit was generating about 2.2 million units till this afternoon and was expected to yield more than three million units by evening, according to a RAPP spokesman. [Text] [Bombay THE TIMES OF INDIA in English 19 Jun 81 p 9]

CSO: 5100/7115

BRIEFS

URANIUM FROM SEA WATER--Takamatsu (Japan), 9 June--Japanese researchers have developed the world's most sophisticated absorbent to extract uranium from sea waters, it was revealed here today. The absorbent was developed jointly by the Government Industrial Research Institute, the University of Tokyo's Institute of Industrial Science and Mitsubishi Chemical Industries' Research Institute. The absorbent, made from acrylic fibre, could extract four milligrammes of uranium per one-gramme absorbent after being immersed in the sea for 10 days, Hidetoshi Miyazaki, Chief of the Chemical Department at the governmental institute, said. The absorbent's capacity of extracting uranium from sea waters is said to be 20 times higher than that of existing technology using titanic acid, he said. The world is in need of such technology to extract uranium from sea waters, since land uranium reserves are expected to be exhausted by 2000, Miyazaki noted. The institute will also gather data for practical use of the new technology as a test plant to be built in Niita, Nagawa Prefecture (state), by the Metal Mining Agency of Japan, he added.--[illegible]/AFP [Text] [Rangoon THE WORKING PEOPLE'S DAILY in English 11 Jun 81 p 6]

CSO: 5100

NUCLEAR ACTIVITIES TO BE REORGANISED

Johannesburg THE CITIZEN in English 30 Jun 81 p 2

[Text]

THE Atomic Energy Board and the Uranium Enrichment Corporation would in future be administered under a single corporate structure, the Minister of Mineral and Energy Affairs, Mr F W de Klerk, said in Pretoria last night.

Such a corporate structure would be constituted in due course by his department.

The Cabinet decision had been the result of the finding of the committee established last month under the chairmanship of Mr A J A Roux, to investigate, among others, whether present nuclear activities, undertaken with funds, should be restructured for greater efficiency.

Mr De Klerk's statement said the recommendations by the committee had been adopted with a minimum of qualifications.

The Cabinet had further decided that the existing activities of the AEB and Ucor would be grouped in three separate subsidiaries.

Transferred

With rationalisation in mind, it had been decided that the Extraction Metallurgy Division of the AEB at the National Institute for Metallurgy at Randburg would be transferred to the institute. Negotiations would be initiated with the University of Pretoria to administer the Life Sciences Division of the AEB as a research institute of the university.

Mr De Klerk said the Board of Control of the new administrative body would in due course make recommendations to his department — after consultation with the head of the Science Planning branch of the Prime Minister's office — on the establishment of a third, new subsidiary.

To further the aims of rationalisation and achieve the most effective use of highly qualified manpower, it was desirable that research that could be done by other government institutions or statutory bodies should be transferred to them as far as possible.

The Cabinet would — as soon as possible — nominate a chairman and a number of members to act as a working group of the proposed nuclear controlling body.

The body would assist the Minister of Mineral and Energy Affairs and the existing management of the AEB and Ucor with draft legislation, grouping current nuclear activities under the new structure.

Other recommendations of the Roux Committee, such as control over the use of radio-isotopes and licensing of nuclear installations would be considered later, in consultation with government departments and other organisations concerned.

Until legislation had been enacted by Parliament to achieve the new grouping, the current managements of the AEB and Ucor would function normally, Mr De Klerk said.

CSO: 5100/4947

NUCLEAR WEAPONS TREATY SIGNING ONLY AT A HIGH PRICE

Johannesburg DIE TRANSVALER in Afrikaans 8 May 81 p 10

[Editorial: "South Africa and Nuclear Weapons"]

[Text] The supposition of Prof Erich Friedland, of Pretoria, that South Africa has the capability of making a nuclear bomb comes as no surprise. Most South Africans are so convinced of this that many speculate with certainty that the country already has "the bomb."

The value of Professor Friedland's supposition on this subject lies in the broader strategic perspective in which he places this matter.

It is clear that for a country such as South Africa nuclear weapons, in the purely military sense of the word, have extremely limited value. To be sure it is clear that the disadvantages probably outweigh the advantages by far.

However, on an international strategy plane South Africa's capabilities in this field have a special diplomatic impact.

In the field of nuclear weapons South Africa is, what is referred to in diplomatic language, a threshold power. If the country is going to sit at international negotiating tables it will do so with an important negotiating card: It can join the nuclear club at any time.

But this is a card which can only be played once. There are no more jacks of spades in the pack.

Therefore this card cannot be put on the table "for trifles" with the signing of a nuclear nonproliferation treaty or for any other reason.

7964
CSO: 5100/4942

NUCLEAR POWER PLANTS DEFENDED AGAINST DEMONSTRATORS

Johannesburg DIE TRANSVALER in Afrikaans 11 Jun 81 p 8

[Editorial: "The Anti-Koebergers"]

[Text] "More people died at Chappaquidick than at Three Mile Island." This was the inscription on a bumper-sticker in the United States. Of course this bore reference to the death of Mary Jo Kopechne when she was at Chappaquicick together with Senator Teddy Kennedy and to the nuclear power station at Three Mile Island in Pennsylvania which went out of order some time ago and released radio active material...but where, nevertheless, nobody died.

But the Three Mile Island incident was nevertheless grist for the mill for many environmentalist organizations in the United States and West Europe, which are now conducting a campaign to abolish nuclear power stations. Typically this way of thinking has now spilled over to South Africa, where an organization known as Koeberg Alert is registering protests against our own first nuclear power station. These people are now again conducting an action against Koeberg, because the Israeli attack on the Iraqui nuclear reactor supposedly "shows" that Koeberg would be "a latent neutron bomb" in the event that a similar attack is carried out against it.

The fears haunting the environmentalists in such instances are regarded as entirely excessive by scientists. The fact is that many more people have died in many other types of accidents than has ever happened in nuclear power stations...as the American bumper sticker correctly points out.

Nuclear power is certainly one of the safer risks of the modern world, and we must learn to live with...simply because of the insufficiency of the other sources of energy.

At this point we must add that we note a certain mania with regard to nuclear power among environmentalists; this is a mania which is least of all reflective of reasonableness and their demonstrations against such a necessity leaves us somewhat suspicious.

7964
CSO: 5100/4944

LONG-TERM INDUSTRIAL MANAGEMENT OF RADIOACTIVE WASTE

Paris CEA NOTES D'INFORMATION in French Apr 81 pp 3-10

[Article by Jean-Marie Lavie, director of ANDRA]

[Text] From 2 to 6 February 1981, the French Radiation Protection Society sponsored, at Cadarache, with the assistance of ANDRA [National Agency for Radioactive Waste Management], a seminar on radioactive waste management.

During this seminar, a survey of the present situation was presented. France is a pioneer in this field, both from the point of view of its organization with the establishment of ANDRA, and from a technical point of view.

Following is a report presented by Mr Jean-Marie Lavie, the director of ANDRA, on the various aspects of the industrial management of radioactive wastes in France.

Why is a National Agency Needed?

While the history of the development of the management of radioactive wastes does not differ at all from the history of the management of other wastes, its transition to the industrial era has, for a number of years, stirred up debates and controversies, both in political circles and in public opinion. This reaction may seem paradoxical, given the relatively low volume of wastes produced by nuclear power plants and the reliability of the management techniques available, in relation to wastes produced by other energy sources. The figures alone should justify the selection of nuclear energy to meet both our energy needs and the requirements of the human environment. It takes only a few figures to show this: France produces about 5 tons per capita per year of wastes of all sorts, while the total of all radioactive wastes comes to only 1 kilogram per capita per year.

However, the acceptability of the industrial solutions which have been or which will be proposed preconditions the development, which is anyway essential, of the nuclear power industry.

These considerations and the urgency to implement industrial solutions suitable for waste elimination, the final major industrial link in the development of the French nuclear power program, have induced government officials to create ANDRA. For, an adequate mastery of all the problems posed by long-term waste management could only be achieved:

a. Within an industrial structure because of the size of the market created by the vigor and extent of the French nuclear program--one power plant begins operation every 2 months--and the consequent fuel reprocessing.

b. Within a public agency in order to guarantee rigorous safety standards, long-term responsibility, and a more fair cost.

c. And on a national basis, in order to ensure the necessary cooperation among all the organizations involved in finding and implementing an industrial solution.

The National Agency for Radioactive Waste Management

The ANDRA was established within the CEA [Atomic Energy Commission] by an interministerial decision dated 7 November 1979. According to the legislative and regulatory provisions in effect, it is responsible for the long-term industrial management of radioactive wastes. Its responsibilities include the following.

a. It is to design, locate, and establish new long-term storage centers and do all the studies required for this purpose, particularly concerning products.

b. It is to provide the management for these long-term centers, either directly or through third parties acting on behalf of the ANDRA.

c. It is to develop, in cooperation with the waste producers, specifications for packaging and storage of radioactive wastes before their removal to long-term storage centers (this is the connection between first-phase and second-phase management).

d. It is to take part in research, studies, and projects dealing with long-term management of radioactive wastes, and their future.

The structures established carry out the intentions of the government officials in the following manner.

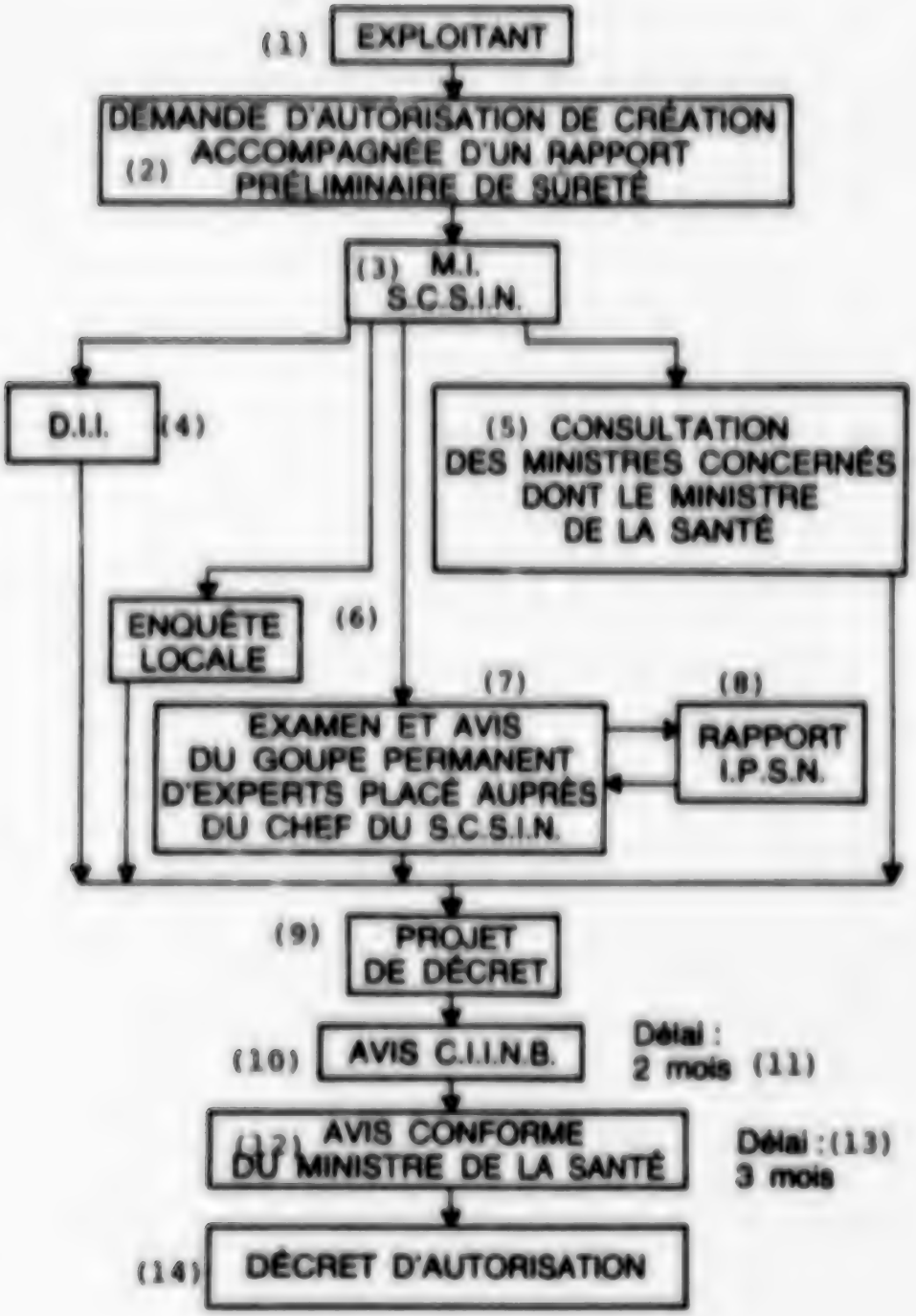

Figure 1: Diagram of the procedure followed to obtain authorization to establish a basic nuclear facility.

Key for Figure 1:

1. Operator
2. Request for authorization to establish facility, accompanied by a preliminary safety report
3. Central Safety Service for Nuclear Facilities
4. [Industrial Installation Request?]
5. Consultation with ministers concerned, including the minister of health
6. Local survey
7. Examination and recommendation by the standing advisory group for the director of the SCSIN
8. IPSN [Nuclear Protection and Safety Institute] report
9. Draft decree
10. INB [basic nuclear facilities] commission recommendation
11. Time elapsed: 2 months
12. Approval recommended by the minister of health
13. Time elapsed: 3 months
14. Authorization decree

a. Radioactive waste management must make use of the most recent developments in science and technology; this is the role of the scientific and technical council of ANDRA, which is chaired by the commissioner for atomic energy.

b. ANDRA's structure expresses an intention to involve in waste management top-level officials and the various organizations which create these wastes; this is the purpose of ANDRA's management committee, chaired by the general administrator of the CEA.

The establishment of ANDRA also expresses the decision made by the government to clearly separate control and regulatory activities from industrial operations. This marks the industrial maturity of long-term waste management, which started within safety organizations, which were often given responsibility for dealing with such operations. These safety organizations, with great discernment, started and supported the first research and development programs conducted in this field.

A storage center is an industrial facility in itself, and since 1963 has been considered a basic nuclear facility. Its nuclear operator, ANDRA, which cannot delegate its responsibility, is thus subject to regulations covering basic nuclear facilities (figure 1), either when formulating a request for authorization to establish a new storage center, or controls of an existing center by the SCSIN [Central Safety Service for Nuclear Facilities] for safety aspects and by the SCPRI [Central Service for Protection against Ionizing Radiations] to verify the lack of environmental impact. It is ANDRA's responsibility to propose industrial policies

and solutions, the responsibility of the safety authorities to make their recommendation, and the responsibility of the government authorities to make the decision.

Let us add also that ANDRA, with a loose structure concentrating its activity on its role as a high-level manager in order to optimize economic and safety aspects, has about 20 staff members, including 15 administrative people. Agents from the CEA, from EDF [French Electric Power Company], and from the COGEMA [Nuclear Materials Company] are assigned to ANDRA, which confirms its specific nature. It relies on the specialized central services of the CEA (figure 2).

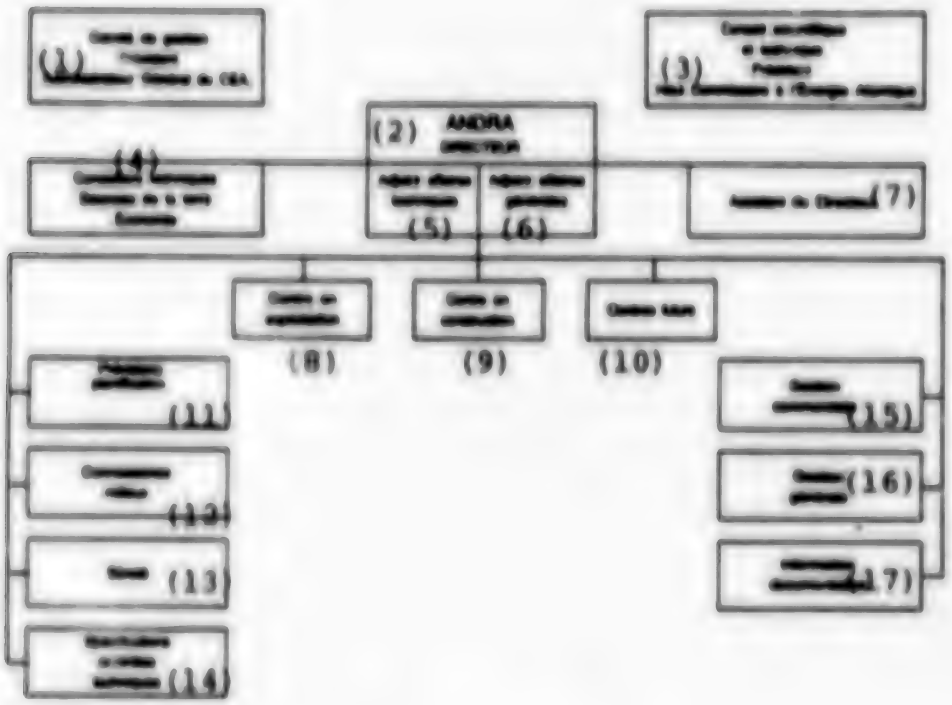

Figure 2.

Key:

1. Management board; chairman: general administrator of the CEA
2. ANDRA: director
3. Scientific and technical committee; chairman: commissioner for atomic energy

4. Technical advisers; earth sciences; economics
5. Deputy for technical affairs
6. Deputy for general affairs
7. Assistant to the director
8. Operating center
9. Center under construction
10. Future centers
11. Scheduling, planning
12. Knowledge of environment
13. Safety
14. Specifications for technical controls
15. Commercial management
16. General management
17. Information and documentation

The Need for a Complete Industrial Approach

With the start of the nuclear power program, it quickly became apparent that the cost of waste elimination (in the strict meaning of the term) was only a fraction--about 10 to 20 percent--of the total cost of waste management (treatment + packaging + storage), and that the cost of storage was directly related to the concept of storage being considered. For this reason it is necessary to know these concepts in advance and very quickly, in order to design first phase management (treatment and packaging) more efficiently and more economically, particularly for the reprocessing plants and for the nuclear power plants.

Optimizing waste management in its entirety in both economic and safety terms requires thus an industrial approach that is homogenous and therefore complete. This approach must cover both the concepts and search for storage centers as well as the treatment and packaging of wastes with the same level of urgency. Anticipation or foresight is needed. It is of no use to improve treatment and packaging methods without knowing the concepts and standard characteristics of the storage centers. ANDRA, which may be asked very specific questions by either EDF or by COGEMA, questions to which it must respond, is therefore attempting to standardize, while still bearing in mind the weight of the past, first and second-phase management of wastes of all categories. Its industrial approach is thus part of a coherent policy of optimized integration of all the factors involved in waste management, in the broad sense of the term, from their first point of origin down to their final storage center. This is part of the producers-storers cooperation program, which the government wanted to establish through ANDRA.

Industrial Management Concepts

The problems caused by the long-term industrial management of radioactive wastes do not differ in their essence from the problems caused by the management of any other wastes covered by the law on waste elimination and recovery of July 1975. In addition to the small volume of radioactive wastes, these radioactive wastes do present two additional advantages over toxic chemical wastes, which are entirely new to the earth's environment: their radioactive decay and their relation to natural radioactivity.

The basic rules covering long-term waste management are to protect the human beings of today and of the future, to preserve the human environment and its resources, and to limit the burden to be borne by future generations. This means:

a. In terms of prevention: a limitation of the production of wastes and above all, of their residual radioactivity to a strict minimum level. This is to be done by sorting and classifying them for a possible later reduction in volume.

b. In terms of protection. This is done by placing barriers between the environment and these wastes, in order to contain them for as long as is necessary, until their radioactivity declines.

After listing these universal principles, we must implement them in industrial terms, which is up to the waste manager. Therefore, as for any other industrial product, we must:

a. List and identify needs, that is,the industrial market, which will be subject to production and delivery schedules for these wastes. These schedules must include not only the volumes but also the nature of the wastes, as well as the times of delivery.

b. Define management concepts which are accessible in technological terms, reasonable economically, satisfactory in terms of safety and the environment, but first and foremost, simple and clear enough to be easily understood and accepted by public opinion. This definition of concepts must try to optimize and reduce both the exposure of workers to radiation and the exposure of both present and future population groups.

c. Select specific sites or at least possible types of sites based on the selection criteria resulting from the concepts selected for long-term storage centers. This selection, not the volume of wastes, is actually the stumbling block in the entire process.

After this first prospective approach is developed and accepted, both by the safety authorities, the government authorities, and the majority of the public, and last but not least by the waste producers, it then becomes possible to define, in a coherent and optimized way:

a. The technical specifications to be met for the packaging and wrapping of the various categories of wastes, which are to be accepted by ANDRA for removal to long-term storage centers. Each type of package is covered by an acceptance procedure by ANDRA. The acceptance documents include, in addition to the characteristics of the packing and the origin of the wastes contained, the record of procedures used in making this waste package.

b. The quality control procedures which ANDRA will implement to ensure that the package meets the standards. This requires that test and control facilities be available.

Furthermore, from this prospective approach, there will be developed a research and development plan applied to long-term waste management. It will be necessary to determine that the objectives and schedules are well covered by the national or multinational programs financed from other resources besides those of ANDRA. If not, other funds will need to be made available, along with other research and development facilities.

Now that we have briefly listed these concepts, which are of universal application, let us now consider the size of the market, that is, ANDRA's workload, before presenting France's policy for dealing with the needs that have been expressed.

ANDRA's Workload

Radioactive wastes, for the purposes of their long-term management and the design of the final storage centers, may be, for a rough approximation, classified into three major categories.

a. Wastes containing radioactive elements with a short half-life, less than 30 years (these are essentially beta and gamma elements) whose content of radioactive elements with a long halflife (essentially alpha) is lower than the thresholds set for the site considered by the safety authorities. These wastes, which are normally called FMA [Low and Medium Activity] wastes, make up over 90 percent of the volume of all radioactive wastes, but have less than 1 percent of the total radioactivity. Their cumulative production by the year 2000 will be less than 1,000,000 cubic meters!

b. Wastes containing a significant quantity of radioactive elements with a long halflife (over 30 years) with a high potential level of harmfulness. In practice, and in order to simplify the terminology, this category is often called "alpha wastes." The alpha content of these wastes is considered significant if it exceeds the concentration threshold set by the safety authorities.

These low and medium radioactivity wastes are produced during the fuel cycle (manufacture, reprocessing); their cumulative production by the year 2000 is estimated to be several tens of thousands of cubic meters.

c. Fission products produced during reprocessing; these are now vitrified. The glasses formed in this process have a high specific radioactivity and therefore release a large quantity of heat. Their total production until the year 2000 will be less than 2,000 cubic meters. They contain 99 percent of the radioactivity produced during the operation of a nuclear power plant.

The reader will observe that while the criterion of external radiation from the packages is important to consider when organizing transport and handling procedures during the period of operation, it does not play a predominant role in the classification process when selecting the method of storage. We should mention that very highly radioactive wastes are characterized by very low volumes, and that wastes with a long halflife have a very low level of radioactivity.

The expected schedules for delivery of wastes to ANDRA constitute the very essence of a coherent storage policy. A remarkable effort has been made on all levels to improve the reliability and precision of these medium and long-term schedules. Quite obviously, simplifying hypotheses have been used. Constant updating will be required as our experience with such operations increases.

Figure 3 gives, as an order of magnitude, the schedules for the annual and cumulative deliveries for some key dates for each of the three categories of wastes.

These schedules do not take into account one major source of wastes: wastes created by the dismantling of nuclear facilities. It seems that the quantity of radioactive materials resulting from the complete closure of a nuclear power plant could correspond to the total quantity of wastes created during the duration of its operation. At a standard operating regime, this could double each year the volume of wastes to be removed. For that reason, further studies should be done in this area.

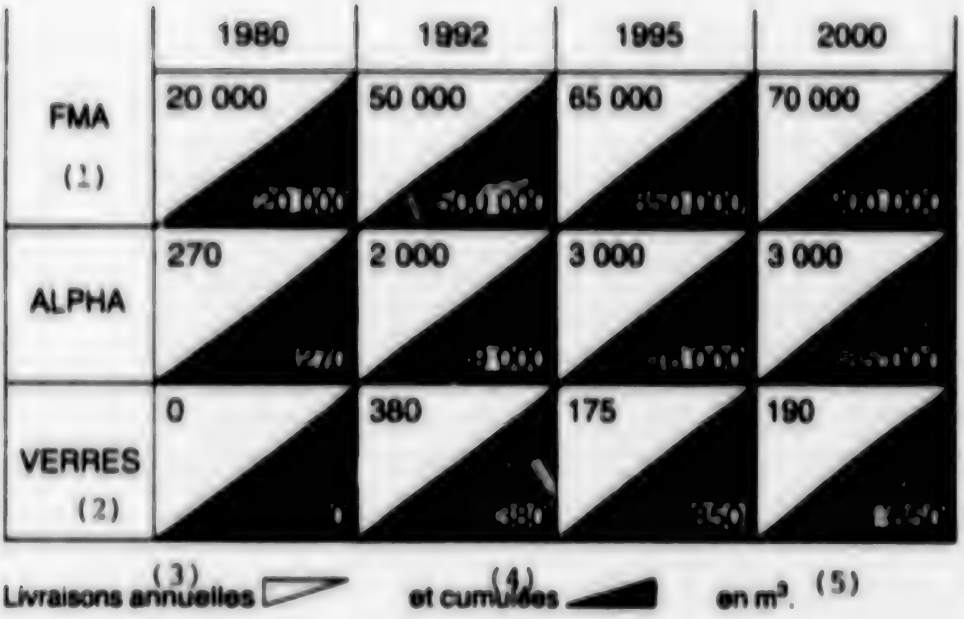

Figure 3: Estimated delivery schedule for specific wastes.

Key:

1. Low and Medium Activity Wastes
2. Glass (vitrified wastes)
3. Annual deliveries
4. And cumulative deliveries
5. In cubic meters

ANDRA has about 10 large waste producers as its major clients. In addition, it has about 3,000 smaller clients which are designated under the name of third parties. These include hospitals, universities, research laboratories, and industry.

French Long-Term Industrial Management Policy (present and planned)

On a practical and industrial level, after the eventual treatment of effluents, the wastes are most often neutralized and then encased in a matrix (cement, asphalt, or resins) or vitrified, and then packaged in a container before being delivered. In actuality, for a variety of reasons, particularly to meet the safety regulations governing transport, and to facilitate their handling, the packaged wastes are placed in quite sophisticated packages. They must then be placed in final storage.

There are four major factors involved in determining France's policy. They are the following:

a. The benefit of radioactive decay;

b. The risk of human intervention or the effects of water;

c. The duration of the effectiveness of the artificial barriers;

d. The total cost of removal.

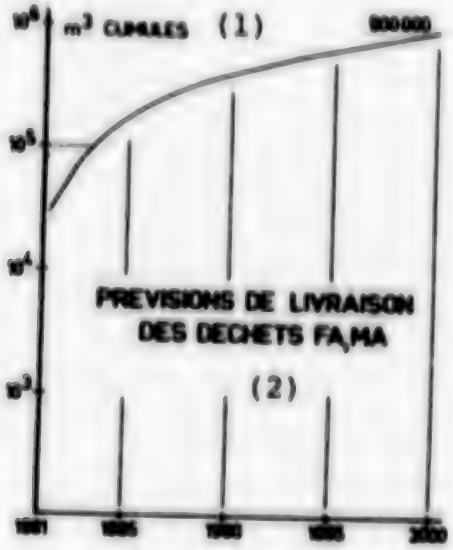

Figure 3b: Schedule for deliveries of low and medium activity wastes.

Key:
1. Cumulative
2. Scheduled deliveries of low and medium activity wastes

Based on the above four factors, there are the following solutions:

a. Surface storage of FMA wastes.

b. Storage of alpha wastes at a suitable depth, depending on their level of harmfulness.

c. Storage of vitrified wastes at some depth in a suitable geological formation, after a preliminary period of cooling.

This policy is already in industrial application for FMA wastes whose safety in surface storage is based on the containment of radioactive substances for a period of time long enough for their radioactivity to decrease, so that the potential risk becomes negligible.

There are three different phases in the life of a storage center.

a. The period of operation during which wastes are placed there and are suitably insulated. This period may last from 10 to 25 years.

b. The period of monitoring after operation, during which no work is done except for possible intervention to make repairs. During this period surveillance is continued. The site remains state property and access is controlled. This period may last from 200 to 300 years.

c. The period of downgrading its status, during which there is no longer any surveillance or intervention, and in which access to and use of the site may become unrestricted. The only lingering risk of dispersion of products with a long halflife would occur in the case in which a threshold had not been set for the wastes accepted in such a storage center. This threshold must be set both for the maximum volumic concentration and for the total radioactivity that can be stored in the center.

In practical terms, considering the progress made in waste packaging, and the high quality of this packaging, it is possible, by the use of special features in the storage center (a single concrete unit, sealed cover, water drainage system), to provide sufficient insulation industrially for the wastes by using artificial barriers (figure 4).

If such features are used, it is possible to be less strict in the requirements for the intrinsic qualities of a surface storage center. This is all the more true as, no matter what these qualities may be, there would be no savings because if such a center is to be acceptable to the public, the artificial containment must have long-term reliability.

However, the real characteristics of the site selected are still determined and taken into consideration in order to make sure that:

a. During the phases of operation and surveillance after operation, the levels of risk in case of any incidents will remain less than what is accepted by national and international regulations.

b. During the period when the status of the center is downgraded, the potential risk levels will remain insignificant no matter what is likely to happen.

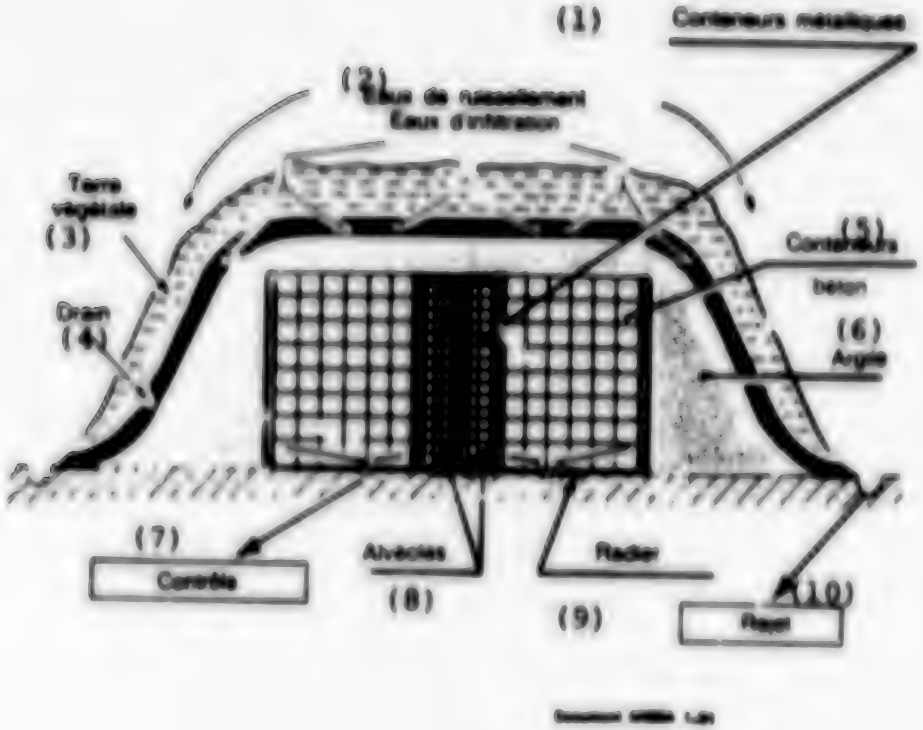

Figure 4: Principle of storage on platforms and drainage system

Key:

1. Metal containers
2. Runoff water/ water seepage
3. Soil
4. Drain
5. Concrete containers
6. Clay
7. Control
8. Cavities
9. Floor
10. Lower area

The acceptability rules for wastes are set based upon the preceding considerations and after making a safety evaluation. The experience we have acquired to date shows that the acceptability rules obtained in this manner will enable us to receive the essential of the beta and gamma wastes that we can expect France to produce.

To meet these storage requirements, ANDRA has the CSM [Manche (English Channel) Storage Center] covering an area of about 12 hectares, with a surface storage capacity of about 300,000 cubic meters for low and medium activity wastes. Approximately 120,000 cubic meters of this area are already in use. With the rate of deliveries growing by about 20,000 cubic meters a year, the CSM should be saturated by 1985-1986, though it does seem wise to reserve the remaining capacity to store wastes coming from the adjacent COGEMA facility and from nearby nuclear power plants. A second storage facility for low and medium activity wastes, capable of handling several hundred thousand cubic meters, will soon be needed, located if possible in the center or southeast of France.

This is why the government decided, when it established ANDRA, to open a second storage center. The Bois Noirs site in the Forez region was chosen and the project was made public in the fall of 1979. The request for authorization to establish the facility was filed on 30 March 1980. If the application is approved, the center is scheduled to open in early 1983. The local survey, which began on 19 May 1980, was completed without any notable incidents on 13 June. This center would take only low and medium activity wastes for final storage.

The capacity of this second center will be several hundred thousand cubic meters of surface storage.

Alpha wastes--wastes whose content of elements with a long halflife does not allow them to be placed in a surface storage facility for their final storage--will be stored in France at a midlevel depth.

The objectives of ANDRA's industrial policy for alpha waste management are the following:

a. To try to develop a long-term underground storage center in a suitable location at an appropriate depth. ANDRA will provide resources for the studies needed to obtain the qualification of this site, with industrial service to begin in 1985 or 1986.

b. To organize temporary storage to meet the most urgent needs.

Vitrified wastes (the packaging solution chosen by France and by a number of countries developing nuclear power plants) are placed temporarily on the surface at the production site. ANDRA is now actively pursuing studies to determine the most suitable storage method for these wastes, both in terms of safety and in terms of economics.

The caloric energy released by these packages is so great that for the first few years after they are produced, it is impossible to bury the glass without taking precautions, for deterioration of the packages and of their environment could lead to unacceptable risks.

Two options are being considered to solve this problem.

a. Cooling near the surface then later transfer to deeper storage.

b. Cooling of the glass at a depth under the ground in a storage facility which could later become the final storage site without having to transfer the wastes.

Moreover, it might seem wise to build a demonstration storage center whose purpose would be to show a very long-term storage facility in actual size.

If the first option is selected, this demonstration storage center could be built; if the second option is chosen, the storage facility itself could demonstrate our skill in this field.

Studies are now being done to evaluate the two options. Significant results should be available by the end of 1981.

No matter which option is chosen, a project should be started in 1982 and a site sought. The facility should be ready to begin service in 1992, at which time the COGEMA will deliver the first glass packages to ANDRA (about 400 cubic meters). The total volume of deliveries expected between now and the year 2000 will reach a maximum of 20,000 cubic meters (figure 5).

Implementation of this Policy

ANDRA's start and implementation of this policy of long-term industrial management is proceeding in an excellent and highly constructive climate of harmony and cooperation among all the organizations involved: producers, safety and government agencies, research organizations, etc.

The technological solutions are essentially available now. The major problem remains the public's acceptance of new storage centers. This is still the stumbling block impeding the completion of this final link in the nuclear power industry.

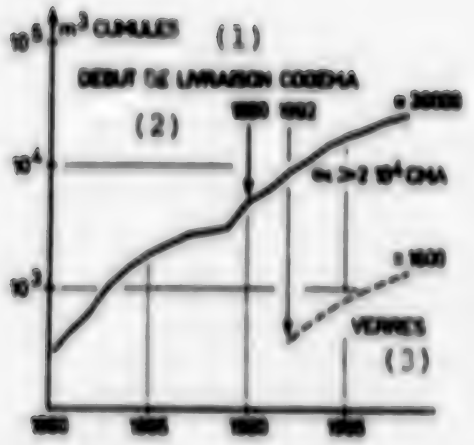

Figure 5: Expected Schedules for Delivery of Specific Wastes

Key:

1. Cumulative cubic meters
2. Start of COGEMA deliveries
3. Glasses

In practice, optimization has produced a certain number of problems in the selection of technical and economic solutions. First of all, there is the weight of the past, a past which is quite honorable. This has required both the waste producers and ANDRA to make a concerted effort to reduce and standardize the number of packages delivered, in order to optimize the handling, transport, and storage facilities, while at the same time paying off the costs of the existing facilities. A catalog listing the acceptable packaging has already been prepared, while we are still waiting for the completion of the acceptance procedures and the records of procedures.

ANDRA, because of its responsibility, plays a fairly direct coordinating role in the transport of the approved packages. In this role, a number of choices must be made: between road transport, which is more flexible, and rail transport, which uses less fuel and is also very safe; between biological protection integrated in the package and a removable shielded container. ANDRA assumes total responsibility for wastes created by small producers. Let us once again remind the reader that there are several thousand of these small producers. Because of this, a standardization brought about in cooperation with the parties involved has enabled us to define the best services at the best price for these producers.

The industrial packaging of wastes may be done:

a. Either in a centralized facility at an ANDRA center.

b. Or it may be decentralized and done by each of the producers, using either fixed equipment or mobile equipment placed there temporarily.

The reduction of radioactivity by lixiviaton, or of the volume of wastes by compacting, crushing, or incineration, though theoretically of interest, must be examined with great care before industrial decisions are made. An aware and cautious pragmatism must be the rule in this field, for the following reasons.

a. Reduction by lixiviation is interesting at first, because it makes the wastes less likely to be carried off by water and reduces their volumic radioactivity. However, in addition to its higher costs, it may cause a dilution of radioactivity by treatment and packaging of the liquid effluents produced by lixiviation.

b. Compacting, whose efficiency is often deceptive, because of the volume occupied by the final packing, and which also requires that the wastes be sorted--and this is not free--may be necessary if the packages are rigidly attached to the storage structure. Often this is the only method of encasing.

c. Incineration, which is necessary for organic solvents, has to be examined not only in the light of its real effectiveness, considering its secondary effects, such as the production of its own wastes or the heating of the packages by concentrating the radioactivity, but also in terms of economics, assuming that the existing technology will enable us to develop nuclear industrial incinerators which can be used for waste products.

In this respect, and in order to put the problem in its proper context, it is good to recall and to stress the fact that the elimination of radioactive wastes is not a problem of volume, even for low and medium activity wastes. (In France, 1 million cubic meters in 20 years compared with 1 million cubic meters a day of wastes of all sorts. Three storage centers such as the CSM, whose area is only 12 hectares, would be enough to store this million cubic meters). It is rather a problem of acceptability to the public.

The cost of compacting, crushing, or incineration to reduce the volume of wastes to be delivered by 1 cubic meters therefore has to be compared with the cost per cubic meter of volume, which is thus being saved at the storage center.

The Cost of Waste Management

What is the cost of radioactive waste management? Might it endanger the economic viability of the nuclear power industry? The converging solutions reached by the economic studies done are reassuring: this cost is only a small percentage of the cost of producing 1 nuclear kWh. However, this low and reassuring percentage must not be allowed to conceal the fact that in absolute value, because of the preponderant share of the nuclear power industry in France's future energy production, when it is applied to the cost of the cumulative energy production until the year 2000, it gives very high costs of roughly several billion francs. In addition, the costs of elimination represent only a part of the total cost of waste management (treatment + packaging + storage), which shows us the size of the market and the urgency for developing removal concepts. On these concepts depend directly the design and cost of first-phase management.

Moreover, our experience with managing the CSM shows that operating expenses are 5 to 10 times the cost of investments. This shows the full value of having ANDRA and the producers work together to standardize the characteristics of the packages to be stored and to seek optimized storage solutions.

Financing ANDRA's Activities

The costs of removing radioactive wastes, like the costs of removing any other wastes, are entirely borne by the organizations which generate the wastes. ANDRA receives no subsidy. It supports itself by the fees it charges for the services it renders. In practice, the financing of ANDRA's activities, as a public agency, is handled in the following way:

a. Operating costs for the ANDRA storage and operating centers are directly billed to the organizations which produce the wastes.

b. Specific investments needed for the storage of particular wastes are financed in advance by the producer of these wastes.

c. Each year there is a pro-rata distribution, based on the actual use, of the charges related to loans contracted to carry out joint investments, within multiyear contracts signed with the different organizations involved, thus guaranteeing the correct operation of the loan service.

For long-term costs, the principle of sharing costs has been adopted. This is comparable to a social security pension system. This was chosen rather than a capitalization system, so that "young wastes" pay for "old wastes." However, a provision is gradually being implemented to handle immediate expenses in case of possible incidents.

As an indication, the 1980 budget, ANDRA's first budget, was approximately 40 million francs, including 17 million for investments. The 1981 budget is 85 million francs, including 44 million for investments. The 5-year plan calls for expenditures of about 700 million francs, of which 400 million will be for investments during the 1980-1984 period. Although it is a monopoly, ANDRA does provide its clients--the major clients are members of its management board--ready access to its management records.

Technical and Scientific Industrial Assistance

The decision establishing ANDRA provided that "ANDRA will handle the management of its centers, either directly, or through third parties acting on its behalf." The concern of the government officials was that in any event, ANDRA should remain in control, that it should not delgate or concede any of its responsibility.

For reasons of flexibility and to avoid any excessive bureaucracy, a light structure was chosen for ANDRA, with assistance being provided from other sources.

In selecting this assistance, two requirements must be remembered:

a. The demand for reliability;

b. The search for the most fair cost.

ANDRA, which has overall responsibility, has turned the management of the CSM over to an operator, which acts under its control. Since 1 January 1981 this operator has been the SISA [Industrial Storage and Purification Company].

The government maintains control of this company, holding a majority of its stock through direct and indirect CEA holdings: CEA, 34 percent; ECO-POL [Ecology and Pollution],(50 percent CEA and 50 percent SERETE [Thermal and Electrical Projects Research and Development Company], 32 percent; and EMC [Mining and Chemical Enterprise], 34 percent.

The start of this industrial policy requires very close cooperation between ANDRA and its operator. For engineering, ANDRA uses a number of industrial research offices.

In addition , for its research and development, ANDRA makes use of the operational units of the CEA, particularly the IPSN, the Reprocessing, Wastes, and Applied Chemistry Study Division, and the Division of Metallurgy and Nuclear Fuels Research. The Reprocessing, Wastes, and Applied Chemistry Study Division has established a research bureau on packaging and containment. ANDRA also makes use of some outside organizations such as the Bureau of Geological and Mining Exploration, mining schools, etc.

This sketch outlining the long-term industrial management of radioactive wastes should give us a better idea of its industrial and economic dimensions, without forgetting its political dimensions. The use of these industrial resources, based on management techniques which have been studied and developed since the very beginning of the nuclear era will enable us to resolve the problem of eliminating radioactive wastes in safety conditions which will generally rival those governing the removal of any other industrial wastes.

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